SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

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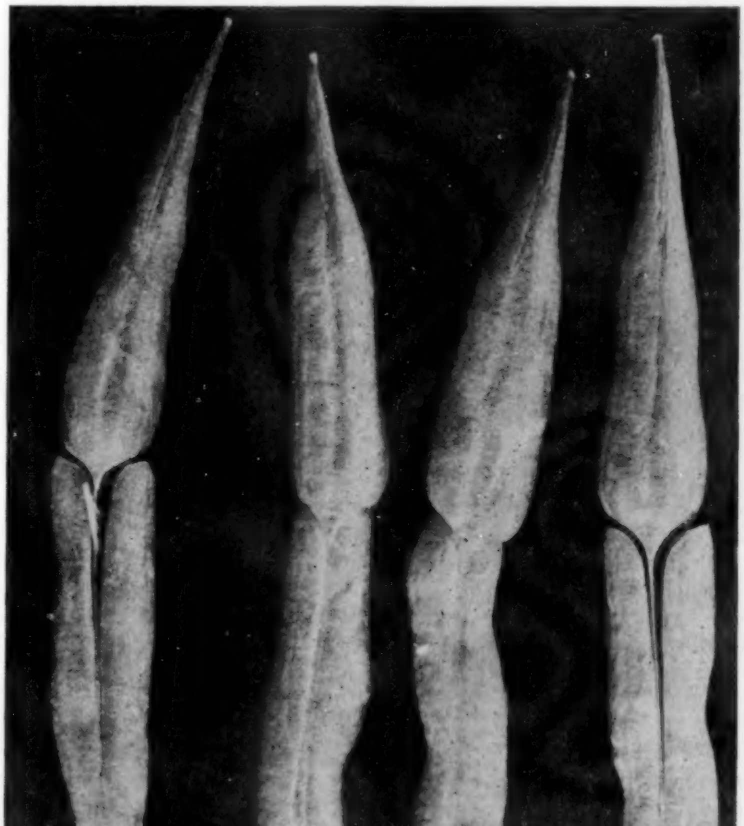

RADDAGE—OR CABBISH?

Weird Combination of Characters in Pods of Hybrid Plant

Vol. XV *No. 409*

Einstein Unites Gravity and Electricity

Physics

By Paul R. Heyl

Dr. Heyl is physicist at the U. S. Bureau of Standards, author of "The Common Sense of the Theory of Relativity" and other works on Einstein's views.

Since the days of Maxwell, over fifty years ago, we have had a mathematical theory of electricity and magnetism due to Maxwell which gives a fairly satisfactory account of the principal electrical and magnetic phenomena. And since Einstein published his general theory of gravitation, now some twelve years ago, we have had a similar mathematical theory for gravitational phenomena. These two theories bear no apparent resemblance to each other.

Now it is a physical fact that gravitation bears a close resemblance to electric and magnetic attraction in that all these forces act according to the inverse square of the distance, and there has been for many years a branch of mathematical physics (Theory of Potential) which handles the elementary phenomena of gravitation, electricity and magnetism by the same identical mathematical treatment. This theory, however, cannot go far, as there is one important feature in which gravitation differs from electricity and magnetism. There is no screen or insulator for gravitation.

Einstein seems to have developed a general mathematical theory for all three of these physical manifestations which includes as special cases Maxwell equations and his own gravitational theory, and automatically provides for the important difference above mentioned—the absence of a screen for gravitation.

The idea is this: Maxwell's equations describe the electromagnetic phenomena, insulation and all; Einstein's relativity theory describes gravitation equally well, including the lack of insulation. In his present paper he has established a common ancestor for these two theories. Like many cases of two sons of the same father, these two theories differ in important traits.

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Two Earlier Papers

The mathematical paper just published by Prof. Albert Einstein by the Prussian Academy of Sciences in Berlin, and heralded throughout the world, is actually the third of a series of short theoretical communications by the great physicist.

As important as the last are two earlier ones. They both appeared in the June 14, 1928, issue of the "Sitzungberichte der Preussichen Akademie der Wissenschaften" ("Proceedings of the Prussian Academy of Sciences"). This is the same journal that has published the new paper.

The first one is entitled "Riemann-Geometrie mit Aufrechterhaltung des Begriffes des Fernparallelismus" ("Riemann Geometrie with the Introduction of the Concept of Distant Parallelism"). It contains sections on "n-Leg Field and Mensuration", "Distant Parallelism and Rotational Invariants" and "Invariants and Covariants." Though only consisting of five pages, it is highly mathematical and gives ten equations.

The second paper, in the same issue, is called "Neue Möglichkeit für eine einheitliche Feldtheorie von Gravitation und Elektrizität" ("New Possibility for a single Comprehensive Field Theory of Gravitation and Electricity"). This occupies only three and a half pages, but is also highly mathematical and includes a sub-section on "The Field Law and Its First Approximation." Nine equations are developed.

Even those working along parallel lines with Einstein will require days of careful and detailed analysis of his formulae and equations in order to obtain the full import and meaning of his new papers.

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In This Issue—

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INTERPRETING week by week, the latest developments in the various fields of science, this magazine attempts also to present its articles in the most pleasing and readable typography and the most convenient arrangement.

The *clippability, indexing,* and *automatic dating* of each article are unique features.

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All of the resources of Science Service, with its staff of scientific writers and correspondents in centers of research throughout the world, are utilized in the editing of this magazine.

The Cabbage That Wed a Radish

Botany—Genetics

By Frank Thone

Once upon a time there was a little cabbage. She lived in the garden of a Russian scientist, who, quite contrary to popular notions, did not look like either Santa Claus or Emil Jannings. He was young, smooth-shaven, and good-looking enough to turn other heads than those of cabbages. His name was Georgii D. Karpechenko, which doesn't sound any queerer in Russia than George D. Carpenter would here.

But it wasn't for the young Russian scientist that the heart of the cabbage fluttered. She was mated to a fiery French radish, a distant cousin of hers, and Dr. Karpechenko was merely the squire who officiated at the wedding. And afterwards when the babies began to arrive (thousands of them!) he kept official record of the posterity of this strange wedding.

A queer posterity it was, too. For there seems to be a prejudice against marrying too far out of the family, in our neighbor world of plants and animals. Mate a donkey and a horse, and you get nothing but mules. Mate a carrot and a beet, and you get—nothing at all. The relationship is too remote. For the breeder the rule is always, make your matings relatively close; the more distant the cousinship, the less chance you have of obtaining offspring, and the less chance the offspring you do get have of amounting to anything. There are a few good hybrids that have become standardized—the mule, for example—but for every success resulting from these out-of-the-family matings there are thousands of failures. The great majority of hybrids are worthless.

It was so with the radish-cabbage wedding that took place under Dr. Karpechenko's hand in the garden of the Institute of Applied Botany at Detskoe Selo, near Leningrad. The offspring were neither cabbages nor radishes, but merely queer rosettes of leaves. They did not make cabbage heads above the ground nor radish roots beneath. In fact, they resembled, outwardly at least, the tufty little ancestral cabbage plants that still grow wild on the cliffs along the North Sea shores. That is the fate of many hybrid crosses; they produce what look like "throwbacks."

Yet in spite of the unpromising looks of the radish-cabbage children, Dr. Karpechenko cultivated them carefully, saved such seed as they formed, and took tender care of the grandchildren plants also, though they turned out no better than their parents from a gardener's point of view. Why? What good reason could a geneticist in a government Institute of Applied Botany give visiting officials, who were not scientific, for using good ground to raise such weeds?

GEORGII DMITRIEVITCH KARPECHENKO, who mated the radish with the cabbage

Well, for one thing, Dr. Karpechenko had done a thing rated as almost impossible; he had made an "intergeneric cross." And no matter how useless they may be, the offspring of an intergeneric cross are such great scientific curiosities that their mere existence is sufficient justification in itself. They are scarcer than two-headed calves or mathematical horses. Only once before in the history of plant breeding do we come upon a record of a cross between a radish and a cabbage. That was made by an American, Dr. G. F. Gravatt of the U. S. Department of Agriculture, back in 1910; but unlike the present hybrid, it was completely sterile and left no descendants. So, on the basis of rarity alone, the job was justified.

To most of us, a hybrid between a radish and a cabbage may seem no more remarkable than that commonplace cross that provides us with mules. But there is a difference, and a big one. For the donkey and the horse are distinct species, to be sure, but nearly related and belong to the same genus; whereas cabbages and radishes, though still related to each other, are at best quite distant cousins and belong to different genera.

According to the naturalists, a species is made up of individual plants or animals quite similar in hereditary make-up, and usually also in appearance, unless breeding and selection have split it up into distinguishable varieties. Thus, all black oaks belong to one species of oak, and all white oaks to another; and in nature all black oaks look more or less like each other, as do the white oaks. All dogs are of the same species, but here artificial breeding has split the species up into separate varieties or breeds, ranging all the way from Pomeranians and Mexican Hairless to St. Bernards and Newfoundlands. Similarly artificial breeding has split up the original cabbage stock into Brussels sprouts, kohl-rabi, cauliflower and several distinct varieties of true cabbage; but these are all children of one species, all varieties of the original stock, known to botanists as *Brassica oleracea*.

Each genus is made up of a number of independent but related species. Thus, all dogs and wolves are included in the genus *Canis*, and all species of oaks in the one genus *Quercus*. Included in the cabbage, or *Brassica*, genus are species that we know as turnips, rutabaga, rape, kale, and the two Chinese cabbages pe-tsai and pak-choi. Crosses between separate species within a genus are easy enough to make; our old friend the mule comes into the picture here, and many varieties of our domestic poultry. The table grapes of the eastern United States are most of them interspecific hybrids, and many of our new and choice western wheats seem to belong to this category. Of course, crosses between varieties within a species are even more abundant; see any mutt dog or alley cat or scrub shote if you want to study the subject.

As species are grouped together to form genera, so related genera in turn are grouped together. Oaks, beeches and chestnuts, for example, are grouped in this way; cats, lions and tigers, and cabbage, radishes, mustard and cresses. But hy- (*Turn to next page*)

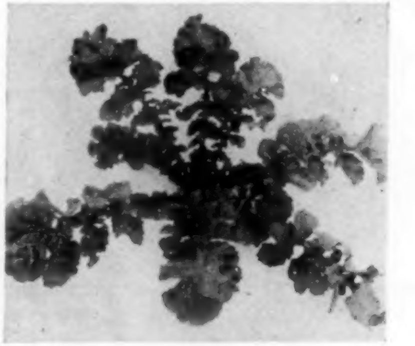
Radish-Cabbage Match—Continued

brids between separate genera are exceedingly rare, and it is in having secured such a cross that Dr. Karpechenko's scientific triumph lies.

Another value in the work of this young Russian may be found in its possible bearing on the study of evolution and the origin of species. There are in existence a considerable number of plant species that resemble related forms in general shape and growth habit, but are so much larger and more vigorous that they are usually considered quite distinct. Coupled with the larger general growth habit is an internal difference that can be found only with a microscope; the bigger plants sometimes have two, three or four times as many chromosomes in a cell as the smaller ones. For this reason some students of plant life believe that the larger plants are nothing but hybrid forms—small plants multiplied internally, as it were.

Chromosomes are specialized bits of denser protoplasm, the "bearers of heredity," according to most biologists, that are to be found in every actively living and dividing cell. In any given species each cell of every individual contains exactly the same number of them as all the other cells. At a certain stage in the reproductive process the number is reduced one-half, but soon thereafter the original number is restored. Biologists have therefore come to look upon its chromosome number as one of the marks of a species, quite as constant as size of seed-pod or shape of flower, and much more dependable as a means of identification than flower color or leaf shape. By crossing a radish and a cabbage, Dr. Karpechenko has succeeded in doubling, trebling and otherwise changing the number of chromosomes in the cells of the hybrid children and grandchildren of this old pair, and thereby gives the students of heredity something more to work on in their pursuit of the ever-elusive riddles of evolution. So, even though the descendants of the cabbage that married a radish will never appear on any dinner table as salad or sauerkraut, they will figure in the dry but important tables of figures compiled by geneticists.

After we have come to a realization of the commercial uselessness of the new hybrids and their sharply contrasting importance in the scientific field, they may be looked upon from a third angle, as objects of great curiosity and interest to the ordinary, non-specialized, average citizen. The marks of their double parenthood stick out all over them. You can put your finger down on almost any part of one of these hybrid plants —should one call them "raddages" or "cabbishes"?—and pick out, here a radish character, there something of unmistakable cabbage origin.



ONE OF THE CHILDREN of the radish and the cabbage

The leaves, for example, have more of the radish shape and arrangement. They never try to head up, but remain as a loose rosette rising a little above the ground. The nearest they come to being a cabbage is to look a little like their old wild ancestor. But though radishy in shape, they are a little cabbagy in texture, being less hairy than typical radish leaves. This habit of forming only a rosette of leaves near the ground persisted into the second generation or grandchildren of the original cross, even though these were again crossed with head-forming varieties—cabbage and Brussels sprouts.

The roots of the hybrids were plainly enough hybrid roots. They were not thickened up into the nice edible globes or spindles that radishes make, but neither were they so strictly thin and fibrous as the roots of regular cabbages. Even in the second generation crossings with cabbage this trace of the radish in the roots still persisted.

When they came to produce their flowers, the hybrids again favored both sides of the house. They produced big, bushy growths of stalk, rather more than either parental type usually grows, and these stalks were heavily burdened with white flowers, intermediate in size and shape between cabbage and radish flowers. Inside, the stalks tended to be like those of the radish, for they were hollow, and the cabbage stalk is typically solid. One unusual feature about the flowers in the hybrids with extra chromosome counts was the tendency to produce extra stamens. The normal stamen number in both radish and cabbage is six, but in these atypical plants there were sometimes eight stamens.

Perhaps the oddest thing about the structure of these cross-bred plants, and at the same time the most easily noticed, is the way the seed pods are put together. Cabbage seed pods are long, slim affairs, opening on the sides with a pair of trap doors running down the whole length, and shedding their seeds through these openings. Radish seed pods are thick and stocky, with a tapering tip; they have no natural mode of opening at all, and release their seeds only when crushed or after they lie on the ground and decay. The pods of the hybrids are of about the same size and shape as radish pods. They have trap-door openings through which the seeds escape, cabbage fashion; but these run only about half-way from the bottom to the top, and the rest of the seeds are left inside the pod to get out as best they can, after the manner of the radish! Nothing so queer has ever been seen in all the half-way compromises which hybrids have had to make between their two parents.

Dr. Karpechenko, fascinated with the results of his first match-making efforts, has also crossed radishes with Brussels sprouts, kohl-rabi, turnip, Chinese cabbage, and several wild *Brassica* species. He has also used instead of the radish a wild species distinct from the cultivated kinds. The technical statement of his results has been published in Russian, and is now being prepared in an English version.

The American predecessor of this Russian radish-cabbage hybrid was described fourteen years ago in the *Journal of Heredity*, but did not attract much attention at the time, and since the strain died out for lack of seed was lost sight of and pretty well forgotten. The description then written by Mr. Gravatt, its originator, tallies fairly well with that now given by Dr. Karpechenko, but differs in some respects. For one thing, Mr. Gravatt's hybrid had leaves more like a cabbage, but they were much larger than the leaves of either parent. The largest of them was five feet nine inches from tip to base of stem, and one foot seven (*Turn to next page*)

National Hydraulic Laboratory Urged

Engineering

A solution to the problem of what governmental agency shall be in charge of a national hydraulic laboratory, if one is to be established, is being sought in hearings before the House Rivers and Harbors Committee.

The Senate has already passed a bill which would establish a national hydraulic laboratory in the Bureau of Standards, but in hearings before the House Committee, both last session and this session, Army engineers have opposed the bill, maintaining that such a laboratory should be under War Department supervision.

Dr. A. W. Beresford, president of the Engineering Council, has appeared in favor of the bill as it stands, declaring that the work is research work and that the work of Army engineers is definitely practical. Army engineers should be able to bring their problems to the laboratory when they desire and have research men work on them, he said.

It would be undesirable, Dr. Beresford maintains, to strike out from the bill the phrase relative to the work to be done by the Bureau of Standards, which reads: "including laboratory research relating to the behavior and control of river and harbor waters", but to strike it out completely would be better than to change the word "including" to "excluding".

Dr. G. K. Burgess, director of the Bureau of Standards, believes that a compromise can be effected which will please both Army engineers and civilian engineers, the latter of whom have come out strongly for the bill.

He anticipates a change in the language which would allow workers in the hydraulic laboratory under the Bureau of Standards, to engage in "laboratory research relating to the behavior and control of navigable waters at the request of the Board of Army Engineers."

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"Raddage"—*Continued*

inches broad. It was intermediate in color between radish and cabbage, and tasted like a cabbage leaf slightly flavored with radish. It was nearly smooth—again like the cabbage. It grew into a tremendous bush, filling one end of the greenhouse where it was set. Before it died of a bacterial root rot, it had grown out of the ventilator of the greenhouse and part-way down the roof on both sides. It bore huge numbers of flowers, but never set a single fertile seed.

A recent issue of the *Journal of Heredity* contained an account of a strange cabbage hybrid originated by a Polish experimenter, C. Moldenhaver. This was a cross between cabbage and Brussels sprouts. As we have already seen, this is not so difficult a thing to get as the intergeneric cross between radish and cabbage, because cabbage and Brussels sprouts are very closely related, being simply cultivated varieties of the same species. But Mr. Moldenhaver's hybrid nevertheless has its very interesting points. It grew a tall, erect stalk, after the fashion of a plant of Brussels sprouts; only the stalk was much taller than its parent variety. On this, at each place where the small, bud-like "sprouts" usually grow, appeared a great, loose rosette of leaves, obviously trying to be a cabbage. If this hybrid could only be improved a little, making it possible to grow six or eight full-sized cabbages on a stalk instead of only one, what a fine world it would be for the makers of sauerkraut! *Science News-Letter, February 9, 1929*

There is one automobile in Russia to each 7,000 inhabitants.

Calves Inherit Disease

Genetics

Calves born with "raw places" on their skin or on the mucous lining of their mouths and noses have been troublesome problems to animal breeders. They have been expensive problems, too, because they invariably die, apparently from infections contracted through the exposed surfaces. For this reason Dr. F. B. Hadley and Dr. L. J. Cole of the University of Wisconsin have conducted a study on the heredity of this defect, and have just reported their findings.

The defects observed by the two Wisconsin scientists have all occurred in herds of Holstein-Friesian cattle, but somewhat similar defects have been observed in the Brown Swiss and Shorthorn breeds. The defects in the Wisconsin Holstein-Friesian cattle all trace back to the same group of ancestors. Study of the cases where they have cropped out indicates that the lesions are due to a genetic trait of the kind known as "recessive," which expresses itself only when both parents carry it in their germ cells. Feeble-mindedness in human beings is a familiar example of a recessive character.

To get rid of the defective strain in a herd completely and immediately would involve more drastic weeding out than would be economically justifiable, in the opinion of Dr. Hadley and Dr. Cole. They suggest instead the elimination only of bulls whose offspring show the defects and the substitution of sires whose pedigrees are clear so far as hereditary skin defects in the family are concerned.

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Jewish Students Score

Psychology

Jewish college students outshine other nationalities in their class work, according to an investigation made by Prof. Henry E. Garrett, of Columbia University, reported in the *Personnel Journal*.

Professor Garrett studied the differences between 296 representative freshmen at Columbia, and found that the Jewish students are far superior both in intelligence test scores and in classroom grades. Students of Italian ancestry do better work than would be expected from their intelligence ratings, whereas with the Irish students just the reverse is the case.

"Classified as to religion, the Hebrew students rank higher than the Catholics and Protestants," Professor Garret reported. "There were no significant differences between Catholics and Protestants."

Native ability may be the cause of the superiority of the Hebrew students, he suggests, but apart from this there are two other possible contributing causes:

"In the first place, it is very probable that the preparation of those Jews who apply for admission to Columbia College is on the whole better than that of the other applicants. Secondly, the standards or criteria for admission are probably somewhat higher for Jewish students."

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Government educators say that India has made more important and far-reaching changes in higher education since 1920 than any other country.

Kant's Ideas of Space

Philosophy

IMMANUEL KANT, in his essay on "Regions in Space," quoted in Kant's *Inaugural Dissertation,* translated by John Handyside (Open Court):

When a body is perfectly equal and similar to another, and yet cannot be included within the same boundaries, I entitle it the incongruent counterpart of that other. To show its possibility, take a body which is not composed of two halves symmetrically disposed to a single intersecting surface, say a human hand. From all points of its surface draw perpendiculars to a plane set over against it, and produce them just as far behind the plane as these points lie in front of it; the extremities of the lines so produced, if connected, then compose the surface and shape of a physical body which is the incongruent counterpart of the first; i. e., if the given hand is the right, its counterpart is the left. The image of an object in a mirror rests upon the same principle; for it always appears just as far behind the mirror as the object lies in front of its surface, and so the mirrored image of a right hand is always a left. If the object itself consists of two incongruent counterparts, as does the human body when divided by a vertical section from front to back, its image is congruent with it, as can easily be seen by allowing it in thought to make a half turn; for the counterpart of the counterpart of an object is necessarily congruent with the object.

The above considerations may suffice for understanding the possibility of spaces which are completely equal and similar and yet incongruent. We now proceed to the philosophical application of these concepts. From the common example of the two hands, it is already clear that the shape of one body can be completely similar to that of another, and the magnitude of their extension exactly the same, while yet there remains an inner difference, namely that the surface which bounds the one cannot possibly bound the other. Since this surface bounds the physical space of the one but cannot serve as boundary to the other, however one may turn and twist it, this difference must be such as rests upon an inner ground. This inner ground cannot, however, depend on any difference in the mode of connection of the parts of the body relatively to one another; for, as can be seen from the examples adduced, in this respect everything may be completely identical in the two cases. . . .

Should we, then, adopt the conception held by many modern philosophers, especially in Germany, that space consists only in the outer relations of the parts of matter existing alongside one another, in the case before us all actual space would be that which this hand occupies. But since, whether it be right or left, there is no difference in the relations of its parts to one another, the hand would in respect of this characteristic be absolutely indeterminate, i. e., it would fit either side of the human body, which is impossible.

Thus it is evident that instead of the determinations of space following from the positions of the parts of matter relatively to one another, these latter follow from the former. It is also clear that in the constitution of bodies differences are to be found which are real differences, and which are grounded solely in their relation to absolute, primary space. For, only through this relation is the relation of bodily things possible. Since absolute space is not an object of an outer sensation, but a fundamental concept which first makes all such sensations possible, it further follows that whatsoever in the outline of a body exclusively concerns its reference to pure space, can be apprehended only through comparison with other bodies.

A reflective reader will accordingly regard as no mere fiction that concept of space which the geometer has thought out and which clear-thinking philosophers have incorporated into the system of natural philosophy. There is, indeed, no lack of difficulties surrounding this concept, if we attempt to comprehend its reality—a reality which is sufficiently intuitable to inner sense — through ideas of reason. This difficulty always arises when we attempt to philosophise on the first data of our knowledge. But it reaches its maximum when, as in this case, the consequences of an assumed concept [that of spatial relations as subsequent to and dependent on the relations of bodies to one another] contradict the most obvious experience.

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A stalagmite in Carlsbad Cavern, in New Mexico, is 62 feet high and resembles the Leaning Tower of Pisa.

Venus Now in Western Evening Sky

Astronomy

By James Stokley

Three planets in the western evening sky during February afford one of the best displays of these earth neighbors that we have had lately. If you look to the west after sunset you will see a very brilliant star low down, near the horizon. This is Venus, of the minus fourth magnitude, as reckoned on the astronomer's scale. It is a little to the north of west. Above, and to the left, is another bright star about minus 1.7 on the magnitude scale, of less brightness than Venus, but brighter than any other stars in the neighborhood. This is Jupiter, largest of all the planets in the solar system. It is about the same magnitude as Sirius, in the Little Dog, which shines in the southern sky, but the sparkling rays from the star are quite different from the steadier, and duller, glow of the planet The reader is referred to this week's "Classic of Science" on page 87 for more details about this interesting planet.

Mars appears in the constellation of Taurus, still higher than Jupiter and farther to the south. It is about zero magnitude, brighter than any star except Sirius. Its steady red light affords a means of identifying it.

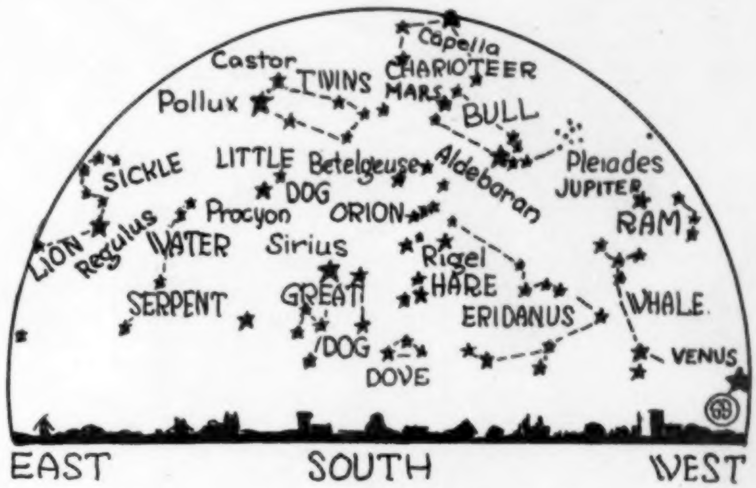
If you have access to a small telescope, magnifying perhaps thirty or forty diameters, look at Venus through it. You will find that, when magnified, it is not round, but semicircular, like the moon at first quarter. By next month a telescope would show it as a crescent, two months ago it would have appeared in a gibbous phase, like the moon when not quite full. In other words, Venus undergoes phases like the moon, but the planet is so much farther away than the moon that a telescope is needed to make the phases evident.

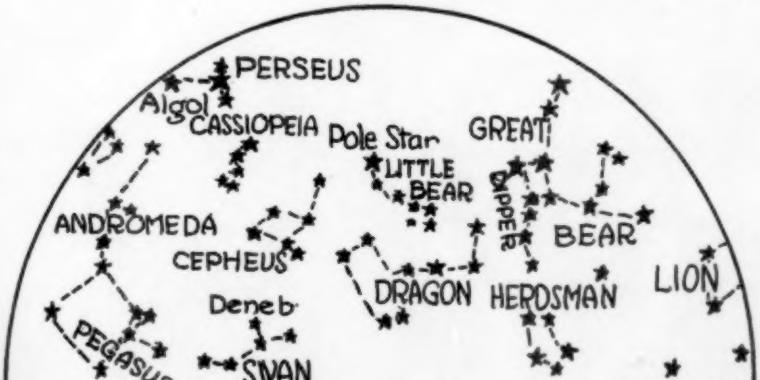
The discovery that Venus imitates the moon in its phases was one of the first to be made at the dawn of the modern era of astronomy. Though men had been watching the stars since the earliest times, in the year 1609 they had no better means of seeing them than had the early Sumerian astronomers 6,000 years before. At both times, men could only see stars with the unaided eye.

In 1610, a Dutch spectacle maker, by the name of Jan Lippershey, in the little town of Middlebourg, noticed that when he held two convex lenses in line at a certain distance from each other and looked through them, distant objects appeared close, though upside down. He hit on the idea of mounting the two lenses at opposite ends of a paper tube, and so made the world's first telescope. The States-General of Holland issued a patent to him for it, but it was principally regarded as a scientific novelty. Uses for it in warfare were foreseen, but it occurred to nobody that there was anything in the heavens that could be seen with it, that could not be seen otherwise. At least, it occurred to no one except an Italian scientist —Galileo Galilei, a Florentine, generally known, like Napoleon, by his first name only.

Galileo did not see one of Lippershey's telescopes, but he heard reports from Holland, in the autumn of 1610, of the invention of this remarkable instrument, made by the combination of lenses, that made distant objects appear close. He realized what a wonderful thing it might be for the study of the heavens, and from his own knowledge of optics, he, too, made a telescope. It was somewhat different from Lippershey's, for instead of two convex, or magnifying, lenses, he used one convex and one concave, or reducing, lens. The magnifying lens was nearest the object at which he looked, and the reducing lens near the eye. Together they gave a magnified view, and one that was right side up. This same combination of lenses, known ever since as the Galilean telescope, is used today in opera glasses.

Galileo lost no time before turning his little telescope on the heavens. He saw Jupiter and four of the moons revolving around it. These moons of Jupiter had been performing their gyrations from time immemorial, but Galileo was the first to see them. Then (*Turn to next page*)





HOLD THESE MAPS IN FRONT OF YOU. The upper then shows you the southern and the lower the northern sky as it appears on February evenings

February Evening Skies—*Continued*

he looked at Venus, night after night, and found that it sometimes appeared as a crescent, sometimes as a semicircle and still other times as a disc.

At that time, the astronomical world was much divided over ideas of the solar system. The orthodox belief was that the earth was at the center of the universe, and that all the other heavenly objects revolved around it. But in 1543 a Polish astronomer, Nicolaus Copernicus, published his great work, "De Revolutionibus," which set forth the then radical idea that the sun was at the center and the earth merely one of a family of planets revolving around it. Galileo, in 1610, was in favor of the Copernican theory, which adherence brought him into conflict, on several occasions, with the church authorities.

It was perfectly well known what caused the phases of the moon. The moon revolved around the earth, nearer to it than the sun, and so it was sometimes on the side of the earth away from the sun. Then it presented a full disc, and was "full". At other times it was at ninety degrees from the sun, we only saw half the illuminated side, and it appeared as a half moon. Then, at still other times, when it was on the same side of the earth as the sun, we saw only a thin sliver of the bright side, and the crescent was the result.

Venus is a round globe, and comes between the earth and the sun, sometimes, when we see a crescent, and at other times is on the other side from the sun and we see the entire illuminated disc. We know this now, but before Copernicus, men thought that the sphere on which Venus revolved was outside that of the sun. Accordingly, Venus could never get between the sun and earth, and could never show a crescent phase. Therefore, when Galileo announced his discovery that "The Mother of loves (Venus) imitates the phases of Cynthia" (the moon), as he expressed it, it became apparent that something was wrong with the old theory. This helped pave the way for the eventual adoption of the Copernican theory universally.

On the seventh of the month Venus is in the quarter phase. After that it will become a crescent, gradually narrowing until April 20. Then it will be directly on line with the sun, and lost to the evening sky. Shortly thereafter it will appear on the other side of the sun as the morning star.

February brings with it a fine display of first magnitude stars, shown on the map. In the south is Orion, with Rigel (lower) and Betelgeuse (upper). Farther east is Sirius, in the great dog, Canis Major. Still farther east, and higher, is Canis Minor, with the brilliant Procyon. High overhead is Capella, in Auriga, the charioteer; somewhat less bright, and to the southeast of Capella, is Pollux, the brighter of the two twins, Gemini. To the west of Orion is Taurus, the bull. In this group is the reddish star Aldebaran, marking the eye of the Bull. In the eastern sky is the familiar Sickle, of Leo, the lion, turned on its back, with first magnitude Regulus at the end of the handle.

Science News-Letter, February 9, 1929

A Thousand Years Ago

Sociology

CLIVE DAY in *A History of Commerce* (Longmans, Green):

A village tried to produce everything it wanted, to be free of the uncertainty and expense of trade. We find, then, that almost all of the people of a village were agriculturists, and these raised the necessary food supply by methods which were always crude, and were very often cumbersome and wasteful. The stock was of such a poor breed that a grown ox seems to have been little larger than a calf of the present day; and the fleece of a sheep weighed often less than two ounces. . . .

Diseases now almost unknown to the civilized world, like leprosy or ergotism or St. Anthony's fire, were not infrequent. The food at best was coarse and monotonous; the houses were mere hovels of boughs and mud; the clothes were a few garments of rude stuff. Nothing better could be procured so long as everything had to be produced on the spot and made ready for use by the people themselves. Finally, these people were coarse and ignorant, with little regard for personal cleanliness or moral laws, and with practically no interests outside the narrow bounds of the village in which they lived. So we read of kings and princes always on the road, travelling with court and retinue from one manor to another, eating up the surplus that had accumulated and then moving on.

Science News-Letter, February 9, 1929

Altar Discovered

Archaeology

Discovery of a remarkable brick-covered altar, rising in a series of steps, has been reported from the Temple of Mekal at Beisan, by Alan Rowe, director of the University of Pennsylvania Museum's expedition in Palestine. The temple dates back almost 3,500 years and was an important building in the Canaanite city referred to in the Bible as Beth-Shan. The altar is more than 16 feet wide and about 12 feet deep.

A small room close by the altar has also been uncovered and in it was found a sloping socket, which once held a wooden peg. Mr. Rowe concludes that this room was intended for use of the temple guard, who stood watch lest any layman approach too near the sanctuary. The peg suggests that the watchman was assisted in his task by a fierce hunting dog.

"In this connection," Mr. Rowe states, "it will be recalled that the magnificent basalt panel which we found only a short time ago depicts lions fighting with dogs. It is probable that this panel originally was placed against the door of the temple, and that the dog shown in each of the two registers of the panel was represented as defending the temple against a lion emblematic of death and destruction."

Among the other latest discoveries, the report cites a great circular oven for roasting the animals slaughtered upon the altar of sacrifice, bronze weapons and chain links, a hairpin, scarabs, and cylinder seals. The altar of sacrifice was a stone structure, in contrast with the great brick-covered altar which was for cult objects.

Science News-Letter, February 9, 1929

Trans-Pacific Air Chart

Aviation

The day when airships and airplanes will regularly sail across the Pacific Ocean is foreshadowed by one of the latest charts issued by the Hydrographic Office of the U. S. Navy. It shows the upper air conditions over the entire North Pacific Ocean for the benefit of would-be Pacific fliers. For over a year the Hydrographic Office has issued similar upper-air charts of the North Atlantic, so that now U. S. Government charts are available for aviators all the way from Europe to Asia.

Science News-Letter, February 9, 1929

A Chinese inventor of the tenth century made a musical kite, like a wind harpsichord.

More Accidents By Women Taxi Drivers

Psychology

The perennial family argument as to whether men or women drivers get into more automobile accidents can at last be backed up with some facts and figures that indicate sex differences.

Records of men and women taxicab drivers in a Pennsylvania city have been watched for an entire year by Dr. Morris Viteles and Helen M. Gardner, of the University of Pennsylvania. The results, reported in the *Personnel Journal,* show that the women taxi drivers were responsible for three times as many accidents as men, though judging by claims following accidents, the women were more successful in keeping out of serious trouble.

These men and women operated the same kind of car, and all equipment was regularly overhauled. Both drove in stormy weather, and in the same traffic conditions. The men, however, were more experienced on the whole than the women, for some of the women were not experienced drivers when hired, but were given a thorough course of training and immediately placed on cabs. This would seem to be an important psychological factor, but the taxicab company records could not be kept in such detail as to show whether the new driver offsets inexperience with excessive caution, or whether this caution oversteps the mark and leads to an excessive number of cases of collisions.

About 2,000 men drivers were on the employment rolls at a time, and about 40 women. The men drove 28,431,719 miles in the year and had 7,311 accidents. The women drove 348,979 miles and had 268 accidents. In terms of revenue the women had three and one-half times as many accidents per thousand dollars as the men.

A special study of accident costs in one representative month showed that there were 191 claims in the accidents of men drivers and four claims in cases involving women drivers. The claims indicate that women got into less serious mix-ups than the men, for the total cost of claims against men was $14,605, as compared with $75 against women drivers.

The psychologists conclude that the figures from the study "favor the point of view that the present generation of women drivers is more susceptible to accidents than the present generation of men drivers."

They also state: "The extent to which this is the result of relative inexperience in driving, or of a sex-determined difference in susceptibility to accidents in traffic, cannot be finally determined from an examination of the present data. The fact, however, that a sampling of women suffer more accidents when driving under the same conditions as a somewhat similar sampling of men is clearly established."

Science News-Letter, February 9, 1929

Tracing Cloth Transparent to Ultraviolet

Physics

Ordinary tracing cloth, such as draftsmen use for their drawings that are to be blue-printed, is likely to become a favorite curtain material on account of a discovery by C. H. Young at McGill University.

Incidental to investigation of the effect of ultraviolet light on blue-print paper, Mr. Young found that the beneficial short wave-length radiation from the sun will pass through the tracing cloth, although the ordinary paper and cloth act as a barrier. A single layer of tracing cloth will, moreover, screen off much of the heat.

He suggests that a single thickness of tracing cloth between wide-meshed wire screens can now replace curtains and blinds and with this screen before an open sunny window it will be possible to enjoy the advantages of ultraviolet light without undue heat or glare. The eyes should be protected, however.

Ultraviolet light, invisible to the human eye, is necessary for healthy growth of human beings and animals. Since the demonstrated effectiveness of sunlight and artificial ultraviolet light in preventing rickets and aiding other disease treatment, many glasses and glass-like substances transparent to ultraviolet light have been placed on the market.

Mr. Young believes that tracing cloth will provide a cheap and effective substitute for these many special glasses and that the material hitherto confined to drawing-boards will find its use in sun-parlors, country cottages and on chicken farms.

Science News-Letter, February 9, 1929

The Background of Modern Physics

Physics

F. K. Richtmyer, in *Introduction to Modern Physics* (McGraw-Hill):

The term "modern physics," taken literally, means, of course, the *sum total* of knowledge included under the head of present-day physics. But by "modern physics," many writers and speakers frequently mean that part of present-day physics which has been developed during the past twenty-five or thirty years; in contradistinction to "classical physics," by which is meant the sum total of physics as it was known in, say, 1890. The justification for the latter use of the term is to be found partly in the fact that advances since 1890 have been very great indeed and partly in the fact that some of these advances have brought into question, or are in direct contradiction to, many of the theories which, in 1890, were thought to be firmly and finally established. For example, few, if any, physicists in 1890 questioned the wave theory of light. Its triumph over the old corpuscular theory was thought to be final and complete, particularly after the brilliant experiments of Hertz, in 1887, which demonstrated, beyond doubt, the fundamental soundness of Maxwell's Electromagnetic Theory of Light.

And yet, by an irony of fate which makes the story of modern physics full of the most interesting and dramatic situations, these very experiments of Hertz brought to light a new phenomenon—the photoelectric effect—which, together with a series of discoveries coming in rapid succession in the single decade, 1887-1897, was the beginning of the development of the now famous quantum theory. This theory is, in many of its aspects, diametrically opposed to the wave theory of light. Indeed, the reconciliation of these two theories, each based on incontrovertible experimental evidence, may be said to be one of the two great problems of modern physics; the other problem being that of the structure of matter.

It shall be the purpose of the following pages to give a brief outline of the origin, development, and, in so far as may be possible in this rapidly developing subject, the present status of these two problems.

But a history of the United States cannot begin abruptly with July 4, 1776. In like manner, if we understand the full meaning of the growth of physics since, say, 1890, we must have clearly in mind at least the main events in the development of the subject up to that time. Accordingly, we shall begin our study by a brief account of the history of physics up to a half-century ago.

In presenting this brief historical survey, however, the author has in mind another purpose, toward which he hopes the reader will be, ultimately at least, sympathetic. Modern scientists have with few exceptions, grossly neglected to cultivate the history of their respective sciences. How many physicists can answer the questions: When was the law of the conservation of energy first enunciated? Who was Count Rumford? Did the concept of universal gravitation spring full-grown from the head of that genius Newton? Indeed, when did Newton live?

Just as any good American should know the essential outline of the history of his country, so any good physicist should know the principal facts in the history of physics. For in that history, in the lives of those men whose labors have given us our subject, and in the part which physics has played in moulding human thought and in contributing to modern civilization, the student will find a story which is as full of human interest and inspiration as is any subject of the curriculum.

What can be more inspiring than the life of Michael Faraday and his whole-souled devotion to his work? Which have had a greater effect on present-day civilization: the victories of Napoleon or the electrons of J. J. Thomson. Was Roentgen when he discovered X-rays seeking a new tool to help surgeons set broken bones?

The physicist owes it to his science to possess such a knowledge of the history of physics as gives *him* a correct perspective of the development and present-day importance of the subject and, in turn, enables him to acquaint his lay contemporaries with these essential facts. If there *is* apathy on the part of the public toward physics, the physicist himself is largely at fault, since he is so absorbed in the interest of the present that he forgets the importance of the past. He would find it much easier to justify to a popular audience the latest experiments on, say, the magnetic spectrum of electrons emitted from targets radiated by X-rays, if he prefaced his remarks by an account of the relation of Faraday's work to the modern dynamo.

It is hoped, therefore, that the student of these pages who proposes to follow physics as a profession, as well as the student whose interest is largely cultural, will extend the following all too brief historical sketch by independent study, particularly of biography.

In order to make it easier to keep the essential facts in mind, we may, somewhat arbitrarily, divide the history of physics into four periods.

The First Period extends from the earliest times up to about 1550 A. D., which date marks, approximately, the beginning of the experimental method. During this long era, there was, of course, substantial advance in the accumulation of the *facts* of physics as a result of the observation of natural phenomena, particularly by the Greeks, whose authority was almost unquestioned for many centuries. But the development of physical *theories* was rendered impossible, partly by the speculative, metaphysical nature of the reasoning employed, but more particularly by the almost complete absence of experiment to test the correctness of such theories as were proposed. The main characteristic of this period, therefore, is *the absence of experiment.*

The Second Period extends from 1550 to 1800 A. D. While numerous basic advances were made during this period—by such men as Gilbert, Galileo, Newton, Huyghens, Boyle, Benjamin Franklin—its most important characteristic is *the development and the firm establishment of the experimental method* as a means of scientific inquiry, as is well illustrated by Galileo's famous experiment (about 1590) of dropping two bodies of unequal weight from the leaning tower of Pisa, thereby proving *by experiment* the incorrectness of the assertion of Aristotle that the heavier body would fall more rapidly—an assertion which had been believed implicitly for nearly two thousand years.

It took two centuries after Galileo's experiment to overcome prejudice, dogma, and religious intolerance and to bring universal recognition, even among scientific men, to the basic principle that . . . *science can advance only so far as theories, themselves based upon experiment, are accepted or rejected according as they either agree with* (*Turn to page* 84)

U.S. Observatory Asks New Instruments

Astronomy

The U. S. Naval Observatory, which thirty years ago was abreast of the world in its scientific equipment and once had the world's largest telescope, is today far behind most other nations.

"For almost a generation," stated Captain C. S. Freeman, superintendent of the observatory, "we have been marking time."

This situation, it is explained. has developed due to the lack of money to buy suitable instruments.

Dr. James Robertson of the Naval Observatory staff, told the House Committee on Appropriations, according to hearings just released, that in connection with his activities as delegate of the Navy Department to the International Astronomical Union at Leiden, Holland, during July, 1928, he visited several national observatories, to find that most were exceedingly up-to-date.

"Where we were giving 25 or 30 years ago, results down to one one-hundredth of a second, the demand now is to have it down to one one-thousandth of a second," he said. "If they were giving then declinations to one-tenth of a second, they demand now one one-hundredth of a second."

Instruments which Dr. Robertson and Captain Freeman have asked for the observatory from Congress in order to bring it up to date are as follows:

A pair of 24-inch doublet photographic objectives for a twin photographic telescope—$50,000.

A 12-inch guiding telescope, with finder and micrometer—$6,000.

Mounting for these items—$20,000.

A 6-inch or 8-inch Ross-type wide-angle lens, with camera and mounting—$9,000.

A 6.5-inch photoheliograph of 60 feet focal length, with mirror, mounting, and clockwork—$8,000.

Measuring engines and plate holders for new astrographic instruments —$7,000.

In addition to these items, the Naval Observatory would like to have $43,000 for replacement and modernization of present equipment; $24,000 for a photographic laboratory; $41,-000 for domes and structural appurtenances for new installations, and $17,000 for research fund for improving the methods of deriving astrometric results by photographic means. The total sum required would be $225,000.

The Bureau of the Budget, though not unsympathetic with the needs of the Observatory, it was explained to the committee, has not seen fit to grant the amount for new instruments and modernization of the Observatory.

The only items in the Naval Appropriation bill now before the House are $174,380 for the Naval Observatory work, including $2,500 for pay of computers on piece work in preparing for publication the American Ephemeris and Nautical Almanac, and in improving the tables of the planets, moon and stars, and $25,700 for miscellaneous expenses.

Plan to Observe Eclipse

With a party of their astronomers now crossing the Pacific to observe the eclipse in the Philippines in May, the U. S. Naval Observatory is already making preliminary efforts to observe the next one. This will happen on October 22, 1930. In the Naval Appropriation Bill, recently reported to the House, an item of $3,600 is included for observations of the eclipse. Owing to the fact that preparations for such observations must be made many months in advance, the eclipse must be thought of now, even though it occurs in the fiscal year ending June 30, 1931, Captain C. S. Freeman, superintendent of the Naval Observatory, told the Appropriations Committee.

With its path of totality crossing the South Pacific Ocean, there are only two small islands from which the eclipse can be observed. One is Nurakita, in the Ellice group, but is flat, thickly wooded, and difficult to reach. The other is Niuafou Island, situated about midway between the groups of Samoa, Fiji and Tonga. It belongs to the principality of Tonga, the only self-governing state in the South Pacific. The chief communication with the rest of the world is by means of the monthly inter-island steamer, from which mail for the island is thrown overboard in a soldered tin can. The natives then swim out and get the can, from which procedure comes the local name "Tin Can Island". The owners of the steamship line have announced that they will probably be able to let the boat stop for a few hours to disembark a responsible party.

Probably the Naval party, if the appropriation is approved, will travel to the American naval base at Tutuila, in Samoa, where a naval tug can be secured to carry the party the remaining 300 miles.

Science News-Letter, February 9, 1929

NATURE RAMBLINGS
By FRANK THONE

Natural History

Coal-Pile Botany

Though there may be a gray blizzard howling out of doors, or the country be locked in the iron grip of a cold wave, there is always a chance to do a little nature-study hike down the cellar steps to the coal pile. The trail leads back more millions of years than there are steps in the cellar stars, too; for it is a long, long time since the black lumps beside the furnace were green herbs and trees in the Carboniferous forests.

Not all coals are really rich in easily traceable plant patterns, but nearly all of them will reward a search with the prints of leaves or stems of one sort or another. The commonest thing to find, of course, is a print like the leaf of a fern. These have been known for a long time, and gave rise to the idea, long held, that most of our coal was formed from ferns. Undoubtedly a good deal of it was, but it has been discovered that some of these fern-leaved plants bore real seeds, which no true fern ever does, and that therefore these plants must be classified with the seed plants in spite of the evidence of their leaves.

Other coal prints will show traces of radiating or star-like whorls of leaves with a slender connecting stem, suggesting the structure of a galium or bed-straw. This was a genus of fern-like vines or scramblers apparently very common in the Coal Age swamps.

Traces of stems are frequently found in coal, marked all over with regularly recurring patterns or with little pits. These are remnants of the "seal-trees" and "scale-trees" of the period; tall, thick-branched objects, whose trunks and limbs were thickly clothed all over with sharp, yucca-like leaves.

Science News-Letter, February 9, 1929

There are 1,465 bears in the National Parks, a new census shows.

Modern Physics—*Cont'd*

or are contrary to other experiments devised to check the theory.

The Third Period, 1800-1890, is characterized by the development of what is now called "classical physics." The experiments of Count Rumford (about 1798) led ultimately to our present kinetic theory of heat. The observations of Thomas Young (1802) and his proposal of the principle of interference (of two beams of light) resulted ultimately in the triumph of Huyghen's Wave Theory of Light over the corpuscular theory, as supported by Newton. And the researches of Faraday gave Maxwell the material for the crowning achievement of this period, namely, the electromagnetic theory.

So profound were there, and many other, developments, that, by 1880, not a few physicists of note believed that all the important laws of physics had been discovered and that, henceforth, research would be concerned with clearing up minor problems and, particularly, with improvements of methods of measurement so as "to investigate the next decimal place." They could not have foreseen that the world of physics was on the eve of a series of epoch-making discoveries, destined, on the one hand, to stimulate research as never before and, on the other, to usher in an era of the application of physics to industry on a scale previously unknown.

The Fourth Period dates quite definitely from the discovery of the photoelectric effect, in 1887. In rapid succession, followed the discovery of X-rays, in 1895; of radioactivity, in 1896; of the electron, in 1897; and the beginning of the quantum theory, in 1900.

So varied and extensive have been the developments in both pure and applied physics from that time to the present that it is difficult to characterize this period by a single appellation. Hence, perhaps one may use the pleonasm "modern physics." Only the historian of a century hence can properly evaluate the growth of physics during the first part of the twentieth century. We, of the present, are too close to it to grasp its full significance.

Science News-Letter, February 9, 1929

Five cities in the United States are officially credited with more than a million population: New York, Chicago, Philadelphia, Detroit and Cleveland.

Life Not Limited

Medicine

Dr. Eugene Lyman Fisk, at the meeting of the American Association for the Advancement of Science:

"I believe I am safe in saying that the average point of view, especially among medical men, is contrary to the thesis of this paper. Even among those who admit offhand that the life cycles of living organisms are not fixed, there is a subconscious conviction that in a practical sense this is so and that it is more or less futile to attempt to interfere with the course of nature or the plans of the deity, depending on the religious or philosophical views of the individual. . . .

"Inasmuch as the body is not an inanimate machine but a physiological mechanism covering waste, maintenance and repair, the fixation of a limit to its existence by other than natural causes more or less under scientific control implies supernatural agencies acting in an arbitrary way.

"Has it been decreed somewhere, somehow, by somebody that the tissues of the human body, or of any other living organism, shall become lifeless within a certain length of time? With those who hold such a view purely as a matter of religious conviction I have no quarrel, but as a scientific proposition it is untenable.

"At once we see the implied and essential fundamentalism of such a view which actually is quite as crude in its aspect as the concept that all existing organisms are descended from those that came out of the Ark. Whether we use the term 'nature' or 'creator,' there is involved in such a concept the inevitable thesis that life cycles of living organisms have been fixed by edict and not through evolution or reaction to conditions in the universe. . . .

"I am able to say, from a fairly broad experience in this field, that one of the greatest obstacles to prolonging human life lies in the acceptance, at least tacitly and subconsciously, of the thesis that such effort is more or less futile, that the years of man are three-score-and-ten, and that it is more important for him to study ways and means of having a good time during that period than in attempting the impossible in endeavoring to work against nature —whatever that may mean—in attempting any emphatic prolongation of the human life cycle."

Science News-Letter, February 9, 1929

New universities have been established at Jerusalem and Saloniki.

Boston public schools have teachers designated as safety counsellors, who promote interest in safety, in addition to other duties.

FIRST GLANCES AT NEW BOOKS

HANDBOOK OF MICROSCOPICAL TECHNIQUE — C. E. McClung — *Hoeber* ($8). Biological workers everywhere will welcome this book. True, they already have on their shelves old standbys on fixing, preserving, staining and mounting; but progress in technique has been rapid during the past few years, and much that is now counted as standard practice can be improved upon. In this new work, twenty-four of the leading anatomists and cytologists have collaborated under the editorship of Prof. McClung, each contributing a discussion of the fraction of the field that has been his own specialty. Such matters as micrurgy, microchemistry, flagella staining and the newer stains here receive their first adequate treatment, aside from the scattered original publications.

Botany—Zoology
Science News-Letter, February 9, 1929

PERSONALITY OF INSECTS; and PERSONALITY OF WATER ANIMALS—Royan Dixon and Brayton Eddy—*Holt* (2 vols., $5). The insects that roam the land and fly the air, and the fishes, crustaceans and other animals that swim the sea are seen in these two interesting volumes as masons, spinners, parfumeurs, warriors, thieves —the whole gamut of human occupations, good and bad; yet the easy, whimsical style guards against the trap of anthropomorphy into which many an unwary popularizer slips.

Natural History
Science News-Letter, February 9, 1929

HANDBOOK OF REFRIGERATING ENGINEERING—W. R. Woolrich—*Van Nostrand* ($4). A book intended, says the author, for two groups of engineers; the mature operating and constructional engineer who desires a complete course in refrigeration. and as a guide to engineering students who take refrigerating engineering as part of their training. On the whole, the book is well prepared, though the type used in a number of the tables is so small that any extensive use of them would be very hard on the reader's eyes.

Engineering
Science News-Letter, February 9, 1929

THE CONQUEST OF ILLUSION—J. J. Van der Leeuw—*Knopf* ($3.50). A militant mystic charges against the windmills of materialism.

Philosophy
Science News-Letter, February 9, 1929

HEALTHY GROWTH — Alfred A. Mumford—*Oxford* ($5). The book gives a study of the relation between the mental and physical development of adolescent boys in a public day school. Dr. Mumford is the medical officer to the Manchester Grammar School, an institution which is said to have found its chief success in the education it gives to the average boy. While the English public school differs in many ways from American schools, boys are pretty much the same all over the world. Sir Arthur Keith in a foreword commends the book to all who are concerned with education—parents, teachers, physicians and statesmen.

Education—Medicine
Science News-Letter, February 9, 1929

BIOLOGIC ASPECTS OF COLLOID AND PHYSIOLOGIC CHEMISTRY — *Saunders* ($2.50). The volume presents a series of lectures given at the Mayo Foundation and the Universities of Minnesota, Iowa, Washington, and the Des Moines Academy of Medicine. The collection covers authoritatively many important questions of colloid chemistry interesting to chemist, physician and biologist. The contributors are Robert A. Millikan, Martin H. Fischer, Robert Chambers, Ross A. Gortner, E. Franklin Burton and William T. Bovie.

Chemistry
Science News-Letter, February 9, 1929

THE BASIS OF SENSATION—E. D. Adrian — *Norton* — ($2.50). The nerves are the basis of sensation discussed in this book. Dr. Adrian approaches his subject from the physiological rather than the psychological or metaphysical standpoint. How sensation is aroused and how messages, transmitted from the sense organs to the brain through the nerves, can be recorded electrically are explained. Included is an account of experimental work done by the author at Cambridge University.

Physiology
Science News-Letter, February 9, 1929

POPULAR KNOWLEDGE—*New York Educational Research League* ($3 per year). The first appearance of a new "Magazine of Information for Everybody". Attractively printed and giving a variety of information in non-technical language about science, history, household affairs, art, literature and sports.

General Science
Science News-Letter, February 9, 1929

CLIMATIC CYCLES AND TREE-GROWTH. VOLUME II: A STUDY OF THE ANNUAL RINGS OF TREES IN RELATION TO CLIMATE AND SOLAR ACTIVITY—A. E. Douglass—*Carnegie Institution Publ.* 289, *Vol. II* (pa. $2.75; cl. $3.75). Dr. Douglass here continues his discussion of his classic studies on climatic cycles as evidenced by growth rings in trees.

Climatology
Science News-Letter, February 9, 1929

COLOR CHART FOR THE DESCRIPTION OF SEDIMENTARY ROCKS—M. I. Goldman and H. E. Merwin—*Natl. Res. Council* (75c). Color blocks, following Ridgeway's system, conveniently arranged on two sheets of convenient size for the geologist's field notebook, with an explanatory guide to their use.

Geology
Science News-Letter, February 9, 1929

UNITED STATES CENSUS OF AGRICULTURE: 1925—Prepared by the Bureau of the Census—*Government Printing Office*. This is a massive three-volume compilation of statistics on every imaginable phase of American agriculture. Crops, farm animals, products sold, supplies purchased, land ownership and tenure—everything on which figures can be gathered is set down here in figures. There is a supplementary 149-page pamphlet summarizing these compendious summaries.

Agriculture—Economics
Science News-Letter, February 9, 1929

COAL IN OKLAHOMA; OIL AND GAS IN OKLAHOMA; MINERAL RESOURCES IN OKLAHOMA; INDEX TO THE STRATIGRAPHY OF OKLAHOMA; PRELIMINARY REPORT ON THE GEOLOGY OF THE ARBUCKLE AND WICHITA MOUNTAINS IN INDIAN TERRITORY AND OKLAHOMA; THE ARBUCKLE MOUNTAINS, OKLAHOMA; PHYSICAL CHARACTERISTICS OF THE ARBUCKLE LIMESTONE; FOSSILIFEROUS BOULDERS IN THE OUACHITA "CANEY" SHALE AND THE AGE OF THE SHALE CONTAINING THEM; OKLAHOMA, THE GEOLOGISTS' LABORATORY—*Oklahoma Geological Survey*. The recent bulletins and circulars of the Oklahoma Geological Survey here listed will be of interest to geologists, especially those interested in the economic aspects of their science.

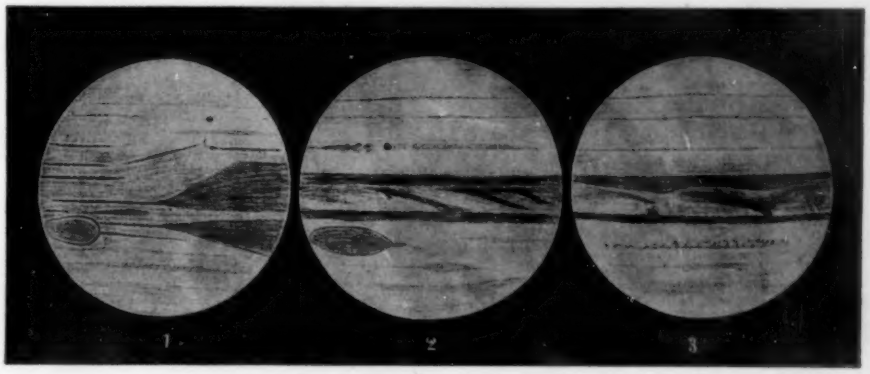
Geology
Science News-Letter, February 9, 1929

CLASSICS OF SCIENCE: Surface of Jupiter

Astronomy

The "Great Red Spot" on Jupiter appeared in the year 1878, although from earlier drawings it seems to have been visible at intervals on many former occasions. In 1878 it caused considerable interest, and observatories all over the world were asked to watch it. Although constantly changing in outline, it has persisted in the same locality ever since, but it now seems to be growing fainter, as though about to be hidden again for another period beneath Jupiter's thick blankets of cloud. Within the last year, it has again come into view, although it is not yet as conspicuous as in 1878.

RECENT CHANGES IN THE SURFACE OF JUPITER. By H. C. Russell, B. A., F. R. A. S. (Read before the Royal Society of New South Wales, 1 December, 1880). Sydney: Thomas Richards, Government Printer.—1881.



THE GREAT RED SPOT OF JUPITER as Russell drew it on three occasions about a month apart

Jupiter's Belts

Some four years since I received a circular from the Royal Astronomical Society requesting my co-operation in the work of systematically observing Jupiter for the purpose of interpreting, if possible, the changing features which the planet presents from time to time to our gaze.

The Sydney 11½-inch equatorial is well adapted for such purpose, owing to its fine defining powers and freedom from uncorrected colour: and in May, 1876, I therefore began a series of observations, making many drawings and notes. At that time the markings were sufficiently remarkable to enlist observers at once, and in the changes which have been going on ever since, sufficient alteration in form has taken place to keep up the interest and make the observer wish that Jupiter were always in the midnight sky, so that these changes might be followed in detail.

Before proceeding to the discussion of my own work, I shall perhaps be forgiven if I detain you a few moments by a very short account of the most important theories which have been put forward in explanation of Jupiter's belts.

In a paper published by Cassini, in Paris, in 1691, he says that the two equatorial belts of Jupiter were first seen in 1630, and he adds that they were remarkably permanent, for he watched them for forty years without seeing any change. Other observers, however, are of a different opinion, and assert that they are not always there. Hevelius says that in 1647 these belts were not visible, although he could see clouds upon the surface clearly, and Sir W. Herschel saw the planet once in 1793 without any sign of belts. In 1834 and 35 the northern belt was invisible, and (coming to my own experience) once in 1863 I saw his face covered with cloud-like forms from pole to pole, the usual equatorial belts being absent.

Cassini and others, judging of the condition of Jupiter from the periods of rotation derived from different markings, came to the conclusion that, since these times differed, the spots used in determining them must have a motion of their own, or that they were simply clouds.

Sir William Herschel in 1793 wrote: "I suppose that the bright belts of Jupiter included between the faint belts are zones wherein the atmosphere of the planet is most densely filled with clouds. The faint belts correspond to the regions in which the atmosphere is perfectly serene, and allows the solar rays to reach the solid portions of the planet, where according to my opinion the reflection is less powerful than from the clouds."

Mr. Proctor, who has made a careful study of the conditions under which Jupiter exists, thinks that since Jupiter, owing to his great distance from the sun, only receives 1/25 part of the light and heat which reach the earth, it is impossible that his atmosphere should be loaded with clouds as we see it, resulting from sun heat alone, and that it is therefore extremely probable that the giant planet is now in the condition which geologists say evidently existed at one period of the earth's history, that is, that Jupiter is "still a glowing mass, fluid probably throughout, still bubbling and seething with the intensity of primeval fires, sending up continually enormous masses of clouds to be gathered into bands under the influence of the swift rotation of the giant planet." Not otherwise, Mr. Proctor thinks, can one understand whence his atmosphere is loaded with vapour masses.

The observed facts which I have to bring before you tonight have an important bearing upon these theories, in part tending to confirm them, and in part contradicting. It will be necessary, however, for us to bear in mind the extreme difficulty of observing the details upon the surface of Jupiter, owing to his enormous distance and the many difficulties which the terrestrial atmosphere puts in our way. It is only the most patient and trained observing, aided by powerful telescopes, that enables us to detect those minute markings on the planet which are all-important in the discussion before us.

There are markings, and even changes, which the possessor of a small telescope may see; but, to study Jupiter to advantage, requires the use of large instruments and very close scrutiny, if we are to arrive at any solution of the question whether there is anything permanent on the surface of the planet or not. The result of my own observation has convinced me that there is, and I think what follows will show that I have some grounds for thinking so. . . .

The Great Red Spot

Next to the great girdles which encircle Jupiter, "the red spot" is certainly the most remarkable feature that has ever been detected upon it; 30,000 miles long by 8,500 miles wide, it covers a surface very much greater than that of the (*Turn to next page*)

Surface of Jupiter—*Continued*

whole of the earth, and is easily seen with good telescopes, but in a powerful one it is a most striking object, and brighter coloured than anything else on the planet; but why that mass of flame-like light is red, and why a different red from any other marking, are questions not yet answered.

It is generally looked upon as a recent marking, and I have been at some trouble to trace its history, and shall, I think, be able to show you that it is much older than many suppose. . . .

I was not long in recognizing it as an old friend that I had frequently seen in 1876, at which time it was involved in the equatorial colour band, and somewhat different in shape but not in colour. . . .

These facts amount to very strong evidence, if not to proof, that the red spot is a fixed feature of Jupiter, or in other words solid ground and not clouds; that it seems to change a little in form is no proof to the contrary, where clouds have so much influence upon visible outline, and the changes in form are really not great. At present both ends are blunt-pointed; in 1876 the preceding end was round and the following pointed; and from Earl Rosse's drawings it appears that the preceding end was pointed and the following end rounded; and such changes are not important. I confess, however, that before I collated my measures the impression produced upon me by observing it was that the dimensions did change considerably. This does not, however, seem to be the case, for the measures show the contrary. . . .

Small White Spots

While writing about the persistent position of this spot, I may mention that on August 6, 1878, at 10 h. 10 m. p. m., I saw a small white spot of striking brilliance, much brighter, in fact, than anything else visible on Jupiter; it was on the northern side of the south equatorial belt, and a little in advance of the red spot. At the time there was a great development of colour between the belts, and this spot presented a clearly defined disc. It was seen again under similar circumstances on October 5, 1878, and thence not again until October 11, 1880, when it seemed to have started into being more brilliant than I had ever seen it before; it looked like some shining white substance laid *on* the dark belt, which it seemed to cut half in two. . . . I have observed that in four instances certainly, and I think in every one, where a spot is visible, there is always to be found on the preceding side of it a cloud-like form.). . . This evident connection between the two markings, and their fixed positions on the surface suggests the idea that the white spots are snow-covered mountains, from which the clouds have for a time lifted; and the diagonal bands similar in colour to the north belt would be clear spaces taking their direction from the mountains. The proof is insufficient to convince one, but quite enough to make the suggestion, and to lead to the hope that we shall know more about it soon. . . .

Earth as Seen From Jupiter

The impression which a close study of Jupiter during the past four years has left upon my mind is that we see on the great planet very much the same phenomena as an observer placed upon Jupiter would see upon the earth; to him our planet would have a very different aspect from that by which we know it. On the polar sides of latitude 40° he would see an almost uninterrupted belt of clouds, shining white in the sunlight, probably almost as white as the snow caps; on the equatorial sides he would see the clearer regions of the trade winds, at times marked by persistent clouds or haze, which would hide every feature of the earth below, at best only visible by light that had passed twice through our atmosphere; and should he be fortunate enough to find the terrestrial air clear at the same time as his own, it would still be next to impossible to distinguish forest-covered earth from ocean; he would carefully note certain white points occasionally seen, and find they were constant in position; and if fortune favoured him, he would look when some terrestrial volcano shot up its ponderous cloud bank, black enough to obliterate everything beneath it, and perhaps, most conspicuous of all, would be the brilliant white cloud ring which generally surrounds the equator, somewhat broken and irregular in outline though it be. Watching these cloud features, he would see them travel north and south with the changing declination of the sun, and wonder whether the few bright points could be the only fixed things on the planet.

Just so, I think it is, that we see Jupiter. Our attention is arrested by the belts. We see on the polar sides of latitude 38° almost uninterrupted bright zones, where there is but little change; but from these latitudes towards the equator the case is different: at one time we find white zones covering everything from 38° to 18° on each side of the equator, as we see it at the present time; at another time all this is changed, and their place is occupied by ever-changing light-red-coloured rings as in 1876. On the equator at one time we see the brightest cloud zone on the planet, and at another a faint red one, which like that between the terrestrial trades is ever changing its features. On each side of this are situated the darkest rings to be found on the planet, and through these probably is our only chance of seeing the true surface.

Henry Chamberlaine Russell (1836-1907), director of the astronomical observatory of Sydney, New South Wales, was an enthusiastic student of the science of his part of the world. His books cover the heavens, the rocks, the plants and the weather of his homeland, and he was the first president of the Australasian Association for the Advancement of Science.

Jupiter is the fifth planet from the sun, not counting the asteroids. It is next beyond Mars, and the nearest of the outer or major satellites of the sun. To the eye it usually appears larger and brighter than any of the stars or planets, except Venus, and it is frequently visible all night. Its mean distance from the sun is 483,200,000 miles. Its distance from the Earth varies from 367,000,000 to 600,000,000 miles. Jupiter's year is nearly 12 of our years, but its day is only about 10 of our hours, for it has the fastest rotation of any of the planets. It is also the largest planet—larger than all the other planets of the sun combined. Its diameter through the equator is 88,640 miles, that through the poles is 82,880 miles. The great equatorial bulge, combined with its size and its density (which is about ¼ that of the Earth) show that its heavy core must be surrounded by much lighter surface material than that of our planet. Red and brown cloud-like masses seem to float on the surface of Jupiter. The temperature of the surface is about -140° C. or 220° below zero F. It is certain, therefore, that this great planet cannot be the home of life as we know it. Conditions on the four chief satellites seem less strange to us, for their surfaces appear to be rough, possibly mountainous like that of our moon. Like our moon also, they keep one side constantly toward their planet. The two satellites nearest Jupiter are believed to be masses of rock, but the outer two, one of which is much more brilliant than the rest, or even than Jupiter, are thought to be perhaps giant snowballs of ice or frozen carbon dioxide. Five other very small satellites of Jupiter are known, making nine in all.

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